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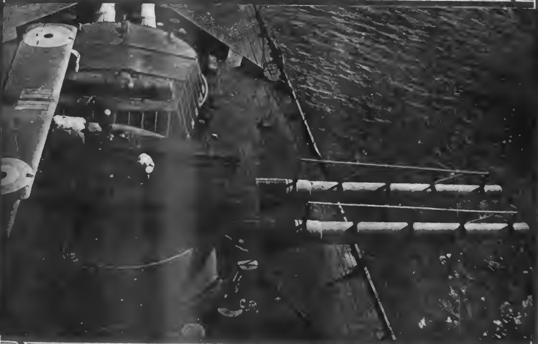
AVIATION

AND

AERONAUTICAL ENGINEERING



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VOLUME V
Number 12

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BRITISH AIRSHIP DEVELOPMENT AND OPERATIONS
DESCRIPTION OF THE LOENING MONOPLANE

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JANUARY 15, 1919 **AVIATION AND AERONAUTICAL ENGINEERING** VOL. V, NO. 12

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AVIATION AND AERONAUTICAL ENGINEERING

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GEORGE NEWBOLD BUSINESS MANAGER

Vol. V January 15, 1919 No. 12

THE annual banquet of the Manufacturers' Aircraft Association, which was this year a particularly representative gathering of men directly or indirectly concerned with aeronautics, emphasized principally two points

The first of these was the magnitude of the industrial firms represented, all of which have since the war been engaged in the pursuit of some phase of aerial navigation. Before 1917 the aircraft industry struggled along year in and year out with insignificant government encouragement, and produced, as a consequence, but limited quantities of airplanes and engines. But with the production program of 1918, based on demands made by the war, many of the larger manufacturing companies have become extensively engaged in airplane production, and this activity has naturally led them to consider the post-war problems of aeronautics Judging by various expressions of opinion, these manufacturers are as a rule far-sighted enough to grasp the great possibilities aircraft afford for public transportation and are making, or have already perfected peace production plans in accordance The vast amount of aircraft production machinery which has been accumulated during the war as well as the engineering talent that has been developed in the pursuit of military requirements is therefore likely to be used in the future for the needs of commercial aeronautics, instead of going to waste through lack of proper comprehension of the problem

The second note which predominated in the conversations at the tables and in the addresses made was that, while the aircraft manufacturers and engineers are determined to develop the field of commercial aeronautics regardless of pessimistic reports from official quarters, they fully realize the necessity of effecting a modification of certain basic conceptions of airplane design, so that aircraft may furnish the maximum of all-round efficiency in the pursuit of peace time objects

For the past ten years every effort in the matter of airplane design has had as its background the development of machines endowed with ever-increasing speed, climb, and maneuvering ability. This tendency has obviously necessitated a good many compromises in terms of maximum safety, such as comparatively high landing speeds, high wing and power loading, low factors of safety, etc While war requirements fully justified such a course, there is no gainsaying that the demands of peace-time, that is civil, aeronautics will needs bring about a considerable change in these engineering conceptions

Reliability must become the first and principal watchword of airplane design and construction Reliability with respect to the materials used, reliability in the matter of assembly work and inspection, and what should perhaps precede these two requirements, reliability in actual airplane conception and design—in brief, all round reliability, this should be the constant endeavor of all those connected with the manufacture of aircraft

Commendable progress has already been made in this respect on comparison of machines turned out today with those produced a few years ago However, the stress of war has often tolerated the adoption of construction standards which were the results of hasty production methods; these must of course be eliminated if the airplane is to become constructionally as reliable—which most emphatically is feasible today—as any other engineering work.

To make of the airplane a machine which will convince the public of its desirability for civilian pursuits the element of safety must absolutely predominate in every feature To acquire this will mean that airplanes for civilian uses will have to embody first of all much lower landing speed than was hitherto customary, this will not only increase safety on landing, but will also permit the use of much smaller aerodromes. Another problem that will require serious consideration is the reduction of wing and power loading, for such a course will increase safety in flight

Besides these problems, which concern the element of safety pure and simple, there are some subsidiary questions which also demand solution, chief among these is the matter of comfort. Development along these lines, assisted by actual demonstration of what airplanes specially designed for the peace-time demand offer to the public, will go a long way toward popularizing aerial navigation for civilian purposes

These are some of the more outstanding reasons which make it undesirable to use merely modified military airplanes for commercial aeronautics. The experience of the Post Office Department shows that superficially altered military machines are unable to give the full commercial service that may justly be expected from airplanes specially designed for this purpose. The sooner this fact is realized, the better will be the performances of commercial aeronautic enterprises

If the gathering of aircraft manufacturers and others concerned with aeronautics had accomplished nothing more than to give mutual confidence in the future of the industry as a producer of commercial vehicles, not to speak of military and naval machines, and to display the remarkably lucid grasp these men have of the principal problems awaiting solution, it would have been well worth while

Properties of the Liberty Aeronautic Fuel

The enormous consumption of gasoline which the use of tens of thousands of automotive apparatus employing this fuel for propulsion, such as aircraft, motor trucks, tanks, service automobiles, submarine chasers, etc., has caused during the war raises the very serious problem of providing for substitute fuels to make up for the rapid depletion of the world's gasoline deposits. Considerable research work has been conducted with this view in the United States, as a result of which an artificial gasoline substitute has been developed by Capt. E. C. Weisgerber, of the Gas and Oil Production Division of the War Department. In accordance with the request of the General Engineering Depot of the United States Army the Bureau of Standards has made laboratory tests of this so-called Liberty fuel the report on which is printed herewith. It is to be noted that the Liberty fuel was prepared from materials and by processes, the specifications of which have not been communicated to the Bureau of Standards, but which the latter understands are in possession of the General Engineering Depot.

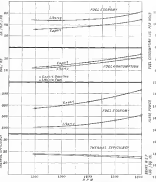
The tests made on the Liberty fuel were of two distinct types (1) tests to determine those physical characteristics of the fuel which have bearing on its use in airplane engines; (2) tests to determine the comparative performance of engines when using the fuels submitted and aviation gasoline.

The physical characteristics which were determined for the Liberty fuel and for the representative fuels with which it was compared are, (1) the total (high) and net (low) heating values, (2) the specific gravities, (3) the distillation temperature characteristics.

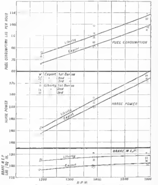
The Liberty fuel was tested in a 150 hp. type A Hispano-Suiza engine fitted with high-compression (5.3:1) pistons and manufactured by the Wright Martin Aircraft Corp. of New Brunswick, N. J. The Liberty fuel was compared with a representative grade of aviation gasoline, fulfilling the specification No. 3512 of the Bureau of Aircraft Production for export aviation gasoline. This gasoline was distilled from Pennsylvania Crudes by the Atlantic Refining Co. of Philadelphia, Pa.

The heating values of the fuel was determined at the Bureau of Standards from a series of careful calorimetric determinations in a Junkers calorimeter.

The distillations were made at the Bureau of Standards in accordance with the method developed by the Bureau of Mines and described in the Bureau of Mines Technical Paper No. 166, entitled Motor Gasoline (Properties Laboratory Methods of Testing and Practical Specifications), by E. W. Dean.



Comparative Performance Chart I

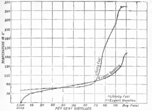


Comparative Performance Chart II

When a sample of the Liberty fuel was cooled to —10 deg. C. (+14 deg. Fahr.), it was found that a considerable amount of crystallization had occurred. This fact shows that the fuel as submitted cannot be cooled much below —10 deg. C. (+14 deg. Fahr.) without serious danger of stoppage in fuel lines and carburetor jets.

In the comparative engine performance test three series of observations were taken. In the first two series, five-minute runs were made at 1200, 1400 and 1600 r.p.m. In the third series of runs, the engine was operated at one speed, 1400 r.p.m., for about 1 hr., 20 min. on each fuel. During this test, oil samples were taken every twenty minutes. The analyses

of these samples are not as yet complete. In all three series of tests, the engine was operated at wide-open throttle and as nearly as possible under constant conditions of oil temperature,

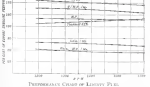


Distillation Curves Using Bureau of Mines Method

oil pressure, water jacket outlet temperature, and carburetor air inlet temperature. The engine was fitted with a Claudel carbureter, which is so constructed that the air to fuel ratio can be varied at will from the control board. Before all runs the fuel mixture was adjusted to give maximum power with the lowest fuel consumption possible. The spark advance was fixed at 20 deg. The spark plugs were cleaned and the gaps adjusted before each run.

In the second series, the revolution counter was used to check the r.p.m. as indicated by the tachometer.

Two readings were made of r.p.m., torque and temperatures, etc., during each run at each engine speed. The revolution



Performance Chart of Liberty Fuel

counter was read each minute for a total of five minutes and showed that the r.p.m. was fairly constant throughout each run.

The object of the third series of runs was to determine if the use of Liberty fuel would dilute the lubricating oil more than standard export gasoline.

Before starting this series of runs, the engine was warmed up and drained of all oil. Then the pump was allowed to draw about two gallons of fresh oil through the engine. After the system had drained throughly, 3.5 gal. of Wolf's Head No. 8 oil were put in. After the engine had been idling for a few minutes, a sample of the oil was drawn off. During the run samples of oil were drawn off every twenty minutes until five samples were obtained.

Before starting these tests new spark plugs were put in for the run on export gasoline, and then fresh plugs were used for the run on the Liberty fuel. The plugs used in the Liberty fuel run showed a slightly greater carbon deposit than the plugs used in the run with export gasoline.

The attached curves give the conclusions reached from the observed data in graphical form.

The results of tests indicate that Liberty fuel, compared with a gasoline fulfilling the export specification for aviation gasoline, will develop about 3 per cent greater horsepower when consuming 10 per cent greater weight of fuel per horsepower hour. The thermal efficiency of the engine when using Liberty fuel is, however, about 2 per cent greater than it is when using the export grade of gasoline.

TABLE I

Fue	Total B.t.u./Lb.	Heating value B.t.u./U. S. gal.	Net B.t.u./Lb.	Heating value B.t.u. U. S.
Liberty fuel	18380	131200	17780	124800
Commercial G. S. C. 1918	20200	128000	18810	119200
Export aviation	20330	120800	18840	112300

TABLE II

Fuel	Specific gravity 60 deg./60 deg. Fahr.	Degrees Baumé	Pounds of fuel for U. S. gallon at 60 deg. Fahr.
Liberty fuel	848	35 0	7 07
Commercial A fuel G. S. C. 1918 E fuel	728 752	62 1 56 2	6 08 6 33
Export aviation	711	66 5	5 93

TABLE III.—FUEL DISTILLATION DATA

	Liberty fuel	Commercial G. S. C. 1918	Export aviation
Initial boiling point	77°C		50°C
10%	79°C		70°C
20%	80°C	50° to 105°	73°C
30%	81°C		78°C
40%	83°C		83°C
50%	83°C	140°	87°C
60%	86°C		91°C
70%	94°C		97°C
80%	173°C		104°C
90%	221°C	175°	118°C
95%	280°C		130°C
Dry point	280°C (96%)	210°	158°C
Residue	1 8%		1 3%
Loss	3 2%		0 7%

Aeronautical Patents

ISSUED OCTOBER 15, 1918

1,281,846—To Tony Salari, Bisbie, Ariz. Aircraft life boat.
1,281,898—To Sherman S. Benson, York, Nebr. Launching apparatus for aerial torpedoes.
1,281,584—To John R. Gammeter, Akron, Ohio, assigned to the B. F. Goodrich Co., New York, N. Y. Balloon window.
1,281,681—To Lewis W. Biggs and Ashley M. Biggs, Wheeling, W. Va. Hydroaeroplane.
1,281,442—To Charles Marie Von Eugen and Harry Leichford, Coventry, England. Construction of wings and the like for aerial machines.

ISSUED OCTOBER 29, 1918

1,283,101—To Arthur Henry Gledhill, Halifax, England. Apparatus for releasing bodies from aircraft.
1,283,190—To Edward Hately Hughes, Canton, Ohio. Aeroplane.

ISSUED NOVEMBER 19, 1918

1,285,229—To Henry Kleckler and Charles G. MacGregor, Buffalo, New York, assignors to Curtiss Aeroplane & Motor Corp. Flying boat hull.
1,285,230—To Henry Kleckler and Charles G. MacGregor, Buffalo, New York, assignors to Curtiss Aeroplane and Motor Corp. Hydroaeroplane pontoon.
1,285,180—To John S. Hoerner, Highland, Ill. Flying machine.
1,285,021—To William Starling Burgess, Marblehead, Mass., assignor to Curtiss Aeroplane & Motor Corporation. Aeroplane wing construction.
1,285,479—To Andreas Marius Von Bessoyce, Sioux City, Iowa. Aeroplane.
1,285,034—To Ben D. Carver, Newlan, Texas. Means of Escaping from aeroplanes.

ISSUED NOVEMBER 26, 1918

1,287,654—To Frederick L. Fales, Jr., Milford, Mass., assignor of one-third to Lewis W. Norton, Ashland, Mass. and one-third to John Goodwin, Milford, Mass. Bomb carrying and releasing apparatus.

National Advisory Committee Report

The fourth annual report of the National Advisory Committee for Aeronautics, which is shortly to be issued, contains a considerable wealth of information on various scientific and technical questions related to aeronautics, which may be gathered from the fact that it includes forty separate technical reports.

Not the least interesting part of this report are the recommendations the committee makes regarding the future development of American aeronautics, and which is given in the report as a conclusion, in fact, these recommendations display such a breadth of views on this subject that precedence is given to them herewith. The conclusion reads as follows:

Recommendations

"The committee believes that the United States are destined to and should rightfully take the lead in the development of aviation for commercial as well as military purposes. There are, however, many problems in aviation which are still unsolved to which reference is made in this report. Other problems will arise. The committee, therefore, emphasizes the need for continuous scientific research and experimentation in aeronautics. The great delays in getting an effective air force into action during the war were due in no small part to the lack of a proper scientific and technical foundation before the war.

"The committee believes that it would be wise for the country to sustain an air service suitable for its immediate needs, but not a large force, as steady progress may be expected in the design of aircraft, and the civil and military services will require constantly in time of peace, but more especially in time of war, only the most improved types.

"Looking to the healthy development of aeronautics in America for all purposes, the committee strongly recommends:

"First, That support be given to the committee in its program for the farther scientific study of the problems of flight, to which reference is made in this report,

"Second, That a continuing, comprehensive governmental policy regarding the construction of aircraft for both civil and military purposes be adopted, and that comparatively small orders be apportioned among competent aircraft manufacturers, thus assuring the existence of a nucleus of an aircraft industry capable of prompt and satisfactory response to military needs when the demand arises,

"Third, That a plan of co-operation be formulated and approved whereby aviators in the military and naval services of the United States may receive continuous training in long distance flying, and at the same time render effective service to the nation by assisting in the work of the aerial mail service,

"Fourth, That legislation be enacted for the regulation of civil aerial navigation, the issuance of licenses to pilots, inspection of machines, uses of landing fields, etc., and that such legislation be so drawn as to effectively encourage the development of commercial uses of aeronautics in the United States, and at the same time guide the development as far as practicable along such lines as will render immediate and effective military service to the nation in event of war,

"Fifth, That the estimates submitted by the War, Navy and Post Office Departments be given full consideration with a view to placing America foremost in the development of aviation for all purposes."

The work of some of the sub-committees is summarized herewith.

Power Plants for Aircraft

New Types of Aviation Engines.—A special sub-committee known as the Fuel Injection Engine Committee was appointed to investigate the possibilities of developing an aircraft engine embodying features of the Diesel or Junkers Diesel oil engines. Some progress was made in the design of such an engine, and the possibilities inherent in this type appear so promising that it is planned to continue the work on this problem.

Supercharging to Maintain Power at Altitude.—Early in the year a comprehensive survey was made of the various possible means for maintaining the charge density, and it was concluded that all but one of the promising types were under satisfactory development, and that the committee could best expedite the final solution by insuring that the one remaining interesting type was made the subject of intensive development. Therefore the Clarke Thomson Research was requested to undertake the problem of supercharging by means of the gear-driven positive blower of the Roots type. Test results are not yet available.

Improvement of Engine Details.—Inasmuch as the life of most aeronautic engines depends to a large extent upon the maintenance of the exhaust valves in a proper working condition, and that the principal reason for the rapid deterioration of such valves is the high temperature at which they have to operate, it is readily seen that the adequate control of the temperature rise of exhaust valve heads constitutes a major problem. The possibilities of several suggested remedies for this trouble have been studied and experiments have been conducted with valves of various designs and materials.

The problem of suppressing the noise of the exhaust has been studied and much experimental work performed in the endeavor to devise a satisfactory form of muffler for aircraft engines. Very encouraging results have been obtained with a newly developed vortex type of silencer.

Radiation Improvement.—A very comprehensive study of the characteristics of all available types of radiator cell construction has been made in three different types of wind tunnels. Experimental work has been completed and results analyzed to the end that the underlying principles of radiator design have been established. In practice the problem is fundamentally one of minimizing the power cost of unit radiation, and this investigation has resulted in several reports which contain especially valuable engineering data. The effect of radiator location on the airplane and of different forms of radiator housing have also been studied, with some rather remarkable results.

Carbureter Improvement.—A study has been made of the performance of several different types of aeronautic carbureters as mounted upon an engine in the altitude chamber. At the same time these and other types have been studied with the aid of a special testing equipment which permitted duplication of the pressure and temperature conditions encountered at all flying altitudes. Special attention has been given to the study and evaluation of the several available methods for compensation, in the endeavor to secure automatic or inherent maintenance of correct mixture proportions under the greatly varying temperatures and pressures encountered.

Two types of automatic carbureter control have been developed to such a point that their operation is superior to any available hand adjustment. A third method is now under development and promises excellent results. It is proposed to continue this investigation of means for automatically compensating for altitude, and to make a special effort to discover means of compensation which will be inherent in their nature and therefore will not depend upon moving parts for functioning.

Some time has been devoted to the study of the atomization of the fuel, in the belief that improvement in this direction is of the greatest importance in bettering both the power output and the thermal efficiency.

Ignition Improvement.—Methods have been developed for the mechanical and electrical testing of the components of the ignition system which had not previously received adequate treatment. The spark plug in particular has been made the subject of exhaustive research as to its design, materials and operation characteristics. An extensive investigation has been conducted on the effect of high temperature upon the mechanical and electrical properties of various ceramic and other materials which could be used for insulators. As the result of a most careful survey of the entire field of ceramic materials, in which a very large number of new porcelains were made and tested, a special porcelain has been developed for spark plug insulators which is markedly superior to any that has heretofore been produced, either in this country or abroad. The electrical, thermal and mechanical strength of this material so far surpasses that of the best previously available as to make this discovery one of the greatest possible importance.

The several causes of failure in spark plugs have been investigated, according to their relative importance, and temperature measurements have been made to determine the effect of different materials in the spark plug shells.

Studies have been made of the effect of changes of pressure and temperature upon the voltage necessary to insure sparking. A method has been developed for measuring the heat energy of ignition sparks, and corresponding tests have been made upon a number of ignition systems. At the same time the character of the electrical discharge has received much attention, as has also the problem of determining magneto characteristics. The effect of the external spark gap, and the correct design of such accessory, has been made the subject of considerable study with a view to determining the best design for a simplified form which would render unnecessary any manual adjustment in order to secure the correct electrical characteristics under varying conditions.

Fuels and Combustion.—An exceptionally complete program of investigation has been completed on the performance characteristics of a considerable number of gasolines and other hydrocarbon fuels as developed under conditions approaching those obtained in actual flying, but which were secured by means of the altitude chamber. While the results of this extended investigation are largely of a negative nature, they have nevertheless, been of the greatest importance in the settling of many questions involving supposed advantages for fuels of extraordinary specifications or composition. However, certain fuel mixtures and chemically altered fuels have shown extremely desirable characteristics, largely by way of permitting greatly increased compression pressures, and therefore increased power output and thermal efficiency.

An engine has been equipped with a new form of apparatus which will enable the determination of absolute values of the rate of flame propagation. It is also expected that it will be possible to measure the rate of combustion. It is proposed that this apparatus shall furnish data with which to explain the differences between the performances of various fuels as obtained in the altitude chamber, and which have been impossible to connect with any of the ordinary properties of the fuels tested.

Three special gas engine indicators have been under development. A sensitive diaphragm indicator with minimum inertia errors has been constructed especially for use in the altitude chamber. This instrument permits the recording mechanism to be operated outside the test chamber at a considerable distance from the engine. Records are made mechanically in rectangular co-ordinate. A self-contained indicator making records of minute size in rectangular co-ordinate has been designed with a view to convenience of installation. No connection is required to the moving parts of the engine. Records of successive cycles are made in series on a transparent film, and afterward are magnified optically 100 to 200 diameters for study.

A greatly improved and simplified form of optical indicator of the polar type has been designed with which it is hoped to obtain pressure diagrams of great accuracy, and which can be used in connection with flame propagation measurements in the study of the phenomena which occur in the cylinder of the modern aircraft engine. This work is of great importance, as determining the direction for the expenditure of effort in the further development of this type of prime mover, and it is intended to carry it on as rapidly as possible.

Lubrication and Lubricants.—A preliminary study has been made of effect of varying oil compositions upon the power output, efficiency and operating characteristics of aircraft engines as far as could be determined by the ordinary methods of conducting such tests. The effect of the mixture of different forms of graphite with the oil has also been studied.

A special single cylinder aircraft engine has been fitted with means for measuring the pressures and temperatures existing in the oil films at all of the important bearing points. This equipment will provide original data of a character which has not heretofore been obtainable, and it is believed that the very complete knowledge thus secured of the actual conditions in the oil film will enable a much more accurate determination of the properties required in oils for aircraft engine lubrication.

A comprehensive laboratory study is being made of the fundamental properties of lubricants, and new kinds of tests have been discovered which throw much light upon the complicated relations existing between the various physical and chemical properties of lubricants.

Steam Aircraft Power Plants.—Although the steam engine was very popular during the very early attempts to solve the problem of mechanical flight, the remarkable development of the internal combustion engine has so greatly surpassed that of the steam power plant that it had been impossible for the latter to approach the results obtained by the gasoline engine for the propulsion of aircraft, either from the standpoint of weight per horsepower output or thermal efficiency. At the present time, however, it is the belief of many aeronautic engineers that a large proportion of the future commercial aircraft will be of much greater size than have so far been constructed. In the larger of present day long-distance bombing airplanes, the total power capacity approximates 2000 hp. If steam power has any chance at all, in competition with the internal combustion engine, it must be in units of large size. Owing to the long and expensive development through which the steam plant must pass, and to the comparatively recent advent of the successful very large airplane, it was impossible to undertake any comprehensive investigation of the problem during the year 1918. However, it is felt that the subject is well worthy of the most serious consideration during the immediate future, and it is the intention to institute such laboratory and experimental activities as will serve to determine the fundamentals required for successful steam power plants for aircraft.

Materials for Aircraft

The following is a brief description of the more important work on this subject done at the Bureau of Standards during the past year:

(a) *Airplane Wing Beams.*—Tests have been made on solid beams of various woods with a view to determining their relative fitness for use as airplane wing spars. The possibility of using laminated beams has also been investigated. The use of built-up members will result in the elimination of much of the waste due to the necessary rejection of much solid stock. Various splices have been tried and recommendations made regarding the most successful types. The results of these tests are given in Technical Report No. 35.

(b) *Wing Ribs and Wing Coverings.*—Tests of wing ribs and wing coverings of metal and other materials are in progress, with the object of developing fireproof wings of lighter weight than the standard wing of fabric and wood.

(c) *Impact Tests.*—An investigation is being made by means of impact tests of the effect of shocks on woods used in airplane construction. This method of testing woods for airplane use has been given but small consideration hitherto, and the data will no doubt be of considerable value.

(d) *Variable Camber Wing.*—A variable camber wing is being developed, and tests on ribs designed for use in such a wing have given promising results.

Steel Construction for Aircraft

The substitution of steel, or other metal, for spruce in airplane wing construction has been carefully considered both theoretically and practically.

Theoretical and experimental work was done at the Bureau of Standards under the direction of Mr. John H. Nelson by Mr. H. L. Whittemore, to whom should be credited the conclusions reached by the committee. The committee also carried on exclusive investigations with the co-operation of the Empire Art Metal Company at its factory at College Point, New York.

This resulted in the construction of two complete sets of metal wings which have been tested at McCook Field, Dayton, Ohio. These wings consisted of steel ribs and aluminum alloy beams, the ailerons being entirely of steel.

These wings proved satisfactory under test both in flight and under load, so it is evident that a similar metal construction can be produced which will have the same strength as wood for equal weight.

A complete technical record of the experimental work on this most important subject is on file in the office of the committee, and the committee is at present encouraging development along several lines by various manufacturers.

Free Flight Tests

The general purpose of these tests is to supplement and make more valuable the information gained from all sorts of tests on the ground, including tests of engines, and tests of airplane parts and airplane models in wind-tunnels. It is obvious that the actual performance in the air, when it becomes known, is the best possible base for future progress.

The committee now has, in a late stage of development, in-

struments for recording in the air the torque and revolutions per minute of the engine, the thrust of the propeller, the air speed, the angle of attack, and the inclination of the wing chord to the true horizon

To secure the necessary degree of accuracy and reliability in the free flight observations, the new instruments have in each case been so designed as to give a continuous autographic record.

The Langley Field Laboratory

The research laboratory located at Langley Field, Va., has been completed and equipped to undertake certain types of research work on aerodynamical problems and aeronautic instruments. Tests of the performance of airplanes in free flight will also be carried out at Langley Field

The wind tunnel building is of brick and steel construction, 43 ft wide, 90 ft long, and 30 ft. high It will house a five-foot modified Eiffel type wind tunnel which has been designed to provide for lessening the diameter of the wind stream to 30 in for high velocity investigations. When operating with the five-foot section, the air stream is left open across the operating room, and when operating with the thirty inch section, the stream is enclosed as in the National Physical Laboratory type of tunnel

The wind tunnel proper will be equipped with a thrust torque dynamometer for propeller investigations and for determining the effect of the fuselage form upon propeller efficiency, also an aerodynamic balance for making accurate measurements on aerofoils Both the balance and the dynamometer will be suspended from an overhead platform down into the wind stream In each case the observer will work above the platform Power will be supplied to the wind tunnel propeller by a 250-hp, direct current, variable speed motor which will be operated by a 250 kw synchronous motor generator set with special arrangements for speed control and regulation

The wind tunnel is designed for air velocities up to 130 m p h. with the five-foot section and for 200 or more m.p h when using the thirty-inch section

Aerological Observations

In order to provide for the local needs of aviation and other military requirements, cooperation with the meteorological work of the Signal Corps has resulted in the establishment of about 25 meterological and pilot balloon stations at properly selected military camps. The work at these stations under military direction consists chiefly in observations of surface meteorological conditions, accompanied by theodolite observations of the flight of small rubber hydrogen inflated pilot balloons The observations with such balloons, when properly reduced, give the path of the balloon in the free air and thus reveal the general horizontal motions according to the altitude of the balloon, the observations also afford some indication of the up and down motions in the atmosphere, as well as the horizontal motions, notwithstanding the steady ascent of the balloon

It is planned in the near future to begin the distribution of systematic reports of the atmospheric motions obtained from these pilot balloons It is believed that much useful information can thus be given concerning the free motions of the atmosphere in different sections of the country, and the stations have been located with a view to making this information most valuable in connection with cross-country flying along lines of civil aerial transport which have already been in a measure agreed upon

Aeronautical Intelligence Office

In January, 1918, the need for a central governmental depository in Washington for scientific and technical data relating to aeronautics was recognized and the Aircraft Board suggested that the National Advisory Committee for Aeronautics was the logical governmental agency for the collection and classification of such data to be made available to the military and naval air services in this country This committee accordingly established an Office of Aeronautical Intelligence and has made the necessary arrangements, at home and abroad, for the collection of such data

Since February, 1918, Dr. W. F Durand, Chairman of the National Advisory Committee for Aeronautics, has served as Scientific Attaché to the American Embassy in Paris, representing the National Research Council on the Research Information service

In September, 1918, Dr W C. Sabine, head of the Department of Technical Information of the Bureau of Aircraft Production and a member of the National Advisory Committee for Aeronautics, was placed in charge of the Office for Aeronautical Intelligence of the National Advisory Committee for Aeronautics, with the title of Director of Scientific and Technical Data

Civil Aerial Transport

The committee believes that federal legislation should be enacted, governing the navigation of aircraft in the United States, and including the licensing of pilots, inspection of machines, uses of landing fields, etc The committee has brought this subject to the attention of the heads of the War, Navy, Commerce, and Post Office Departments, and suggested that representatives be appointed to confer with the committee with a view to studying the problem

Electro-Magnetic Synchronizer

An electro-magnetic synchronizing gear for machine guns has been evolved which will perform all the functions of the hydraulic and mechanical gears, and with an efficiency fully as great. It has certain marked advantages, such as flexibility of mounting, this will enable the machine gun to be traversed in a horizontal plane, while at the same time being maintained in perfect synchronization

Veneer Wing Construction

Sand loading and other test made by members of the committee's technical staff on an experimental airplane built by the Carolina Aircraft Company, revealed the utility of wood veneer in wing construction, not only for ribs but also for the actual wing covering It was found that the internal drift wires may be eliminated and the same weight per square foot of surface obtained as in the ordinary wing

Airplane Mapping Camera

Through the direct efforts of the Airplane Mapping Committee, a triple lens airplane mapping camera was developed which was brought promptly and personally to the attention of the proper Army and Navy officers, and the camera itself turned over to the Geological Survey at its request In the hands of the officials of this Survey it has already proved to be of inestimable value in making topographical surveys

Aircraft Engine Fuels

Research and experiment have been conducted by Messrs. Paris at Charleston, under the direction of the National Advisory Committee for Aeronautics, on aircraft engine fuels. The subjects investigated during the past year are as follows

1. Gasoline direct from crude petroleum without still cleaned without use of acid or alkali
2. First distillate of crude benzine, cleaned, and purified without the use of acid or alkali
3. Natural neutral gasoline
4. Increased yield of straight paraffin gasoline from crude oil.
5. Separation of gasoline from crude oil by mechanical means

Technical Reports

The first annual report of the committee contained technical reports Nos 1-7, the second, Nos 8-12, the third, annual report, Nos. 13-23 The fourth annual report contains technical reports Nos. 24-63, as follows

Report No 24, "Air Flow through Poppet Valves by C. W. Lewis and E M Nutting, of the Clarke Thomson Research

Report No 25 "Nomenclature for Aeronautics," adopted by the committee in October, 1918.

Report No 26 "The Variation of Yawing Moment Due to Rolling," by Prof E B Wilson, of the Massachusetts Institute of Technology

Report No 27, "Behavior of Airplanes in Gusts III" by Prof E B Wilson, of the Massachusetts Institute of Technology

Report No 28, "The Laws of Air Resistance of Aerofoils" by Dr George de Bothezat, of the Technical Staff of the committee

Report No 29, "General Theory of the Blade Screw," by Dr George de Bothezat

Report No 30, "Experimental Research on Air Propellers II," by W. F. Durand and E P Lesley

Report No 31, "Accuracy and Efficiency of Pressure Nozzles," by Dr A F Zahm, of the Department of Construction and Repair, Navy Yard, Washington, D C.

Report No 32, "An Airplane Tensiometer," by L. J Larson, of the Bureau of Standards

Report No 33, "Luminous Materials," by Dr N. E. Dorsey, of the Bureau of Standards.

Report No 34, "Aluminum and Its Light Alloys," by Dr. Paul D Merica, of the Bureau of Standards

Report No. 35, "The Strength of One-piece, Solid, Built-up, and Laminated Wood Airplane Wing Beams," by John H Nelson, of the Bureau of Standards

Report No 36, "The Structure of Airplane Fabrics," by E D Walen, of the Bureau of Standards

Report No 37, "Fabric Fastenings," by E. D. Walen and R T Fisher, of the Bureau of Standards

Report No 38, "Airplane Dopes and Doping," by W H Smith, of the Bureau of Standards.

Report No 39, "The Testing of Balloon Fabrics," by Junius David Edwards and Irwin L Moore, of the Bureau of Standards.

Report No 40, "The Ferrosilicon Process for the Generation of Hydrogen," is a series of three papers prepared by the staff of the Bureau of Standards Their titles and authors are as follows "Generation of Hydrogen from Ferrosilicon and Sodium Hydroxide," by E R Weaver, W M Berry, and V. L. Bohnson, "The Effect of the Presence of Sodium Carbonate on the Generation of Hydrogen from Ferrosilicon and Sodium Hydroxide," by E R Weaver and B. D Gordon "The Use of Lime in the Generation of Hydrogen by the Use of Ferrosilicon," by B D Gordon

Report No 41, "Testing of Balloon Gas," by Junius David Edwards, of the Bureau of Standards

Report No 42, "A New Process for the Production of Aircraft Engine Fuels," by Auguste Jean Paris, Jr., and W Francklyn Paris, first lieutenant, U. S A

Report No 43, "Properties of Aerofoil Sections," containing "Profiles and Aerodynamic Characteristics of Aerofoils," by L C Stearns, and "An Analysis of the Aerodynamic Properties of Aerofoils," by L. C Stearns and John H DeKlyn.

Report No 44, "Description of Altitude Laboratory," by Herbert Chase.

Report No 45, "The Effect of Compression Ratio, Pressure, Temperature, and Humidity on Power"

Report No 46, "Heat Distribution in an Aircraft Engine"

Report No. 47, "Power Characteristics of Fuels for Aircraft Engines"

Report No 48, "Carbureting Conditions Characteristic of Aircraft Engines," by P S Tice

Report No 49, "Metering Characteristics of Carburetors," by P S Tice

Report No 50, entitled "The Junkers-Diesel as an Aircraft Engine," by Wm D Halsey, a member of the Engineering Staff.

Report No 51, "Spark Plug Defects and Tests."

Report No 52 "Temperatures in Spark Plugs having Brass and Steel Shells."

Report No 53, "Properties and Preparation of Ceramic Insulators for Spark Plugs"

Report No. 54, "Effect of Pressure and Temperature on the Sparking Voltage"

Report No 55, "Oscillograph Tests of Ignition Systems."

Report No 56, "Heat Energy of Various Ignition Sparks."

Report No 57, "The Series Gap as a Means for Improving Ignition"

Report No 58, "Transformation Ratio and Coupling in High Tension Magnetos"

Report No 59, "General Analysis of Airplane Radiator Problems."

Report No 60, "General Discussion of Test Methods for Radiators"

Report No 61. "Head Resistance due to Radiators."

Report No 62, "Effect of Altitude on Radiator Performance."

Report No 63, "Water Flow Through Radiators"

Book Reviews

AEROPLANE CONSTRUCTION AND OPERATION By John B Rathbun (Stanton & Van Vliet Co, Chicago Price, $2 00 426 pp Illustrated)

The greatest merit of this book lies in the fact that it constitutes a sufficiently complete reference work of handy size on customary airplane construction methods as well as on airplane design proper

Most works dealing with the airplane from the purely technical point of view are almost exclusively devoted to dissertations on aerodynamic theory and its effects on the airplane, but generally fail to illustrate by practical examples how this theory may promptly be translated into practice and applied to the construction of airplanes Mr Rathbun's book, besides filling this long felt want, contains also some interesting notes, well illustrated, on present methods of airplane construction, these are unfortunately not very extensive, but they deal with sufficiently representative types of machines to suffice for purposes of general reference

PRACTICAL AVIATION, INCLUDING CONSTRUCTION AND OPERATION By Maj J Andrew White (Wireless Press, Inc, New York. Price, $1.75 200 pp 200 ill)

Here we have the first textbook that has so far been published on military aviation, and, such being the case, it may appear that the title of the book is rather misleading Apart from this remark, however, only good can be said of Practical Aviation, which has been written in a simple and concise style by a military man for military men, and contains in condensed form the elements of aero-military science which our Army aviators are absorbing at ground and flying schools.

The chapters dealing with the theory and principles of flight, the elements of airplane design, motive power, materials, stresses and strains, are sufficiently comprehensive to give the student a fair all-round theoretical knowledge of the machinery he is expected to take aloft, these are succeeded by a number of chapters dealing with the practical side of aviation, insofar it concerns the military aviator. First flights, cross-country trips, aerobatics, night flying, aerial gunnery, combat, bombing, reconnaissance, and gun spotting are very extensively dealt with, and all these subjects are excellently visualized by means of practical examples and illustrations.

THE A B C OF AVIATION By Capt. Victor W. Page, S.R.C, A S (The Norman W Henley Publishing Co., New York Price, $2 50 274 pp 130 ill, 7 plates.)

This elementary textbook, by the well known author of Aviation Engines, has been written with special reference to the requirements of non-technical men, such as soldiers, mechanics and students who have taken up aviation and who desire authoritative, easily understood explanatory matter relative to all types of air craft. It can be understood by anyone because elementary principles of flight are considered and fully explained before instructions are given for lining up or adjusting airplanes. These basic principles are clearly stated and illustrated with specially prepared diagrams. The instructions are based on a series of lectures given aviation students by the author when instructing in aerodynamics and airplane flight at one of the Signal Corps aviation schools.

AERO ENGINES, MAGNETOS AND CARBURETORS By Harold Pollard (The Macmillan Co, New York Price, $1 00 84 pp. 31 ill.)

This unpretentious little book of pocket size contains more practical, common sense information on the working and ailments of aero engines and their component parts than may be found, often at a considerable expense of time and efforts, in many a reference work of impressive proportions.

The author, who is a Lieutenant in the Royal Air Force, and an engineering medallist of the Halifax, England, Master Federation of Engineers, is gifted with a lucid style which enables him to explain even the more obscure points of the aero-engine in a manner so simple and clear as to make it understandable to the non-technical man This book can be warmly recommended to air mechanics, although pilots, too, will find it worth their while to consult it in emergencies.

Use of Airplanes in Forest Patrol Work

By Henry S. Graves

Chief, United States Forest Service

As long ago as 1909 a resolution was passed at a meeting of Forest Supervisors, held in El Paso, Texas, to the effect that the use of aircraft in fire patrol of the National Forests was something that should be looked forward to. I refer to this incident simply to show that Government forest officials for some time past have not been unmindful of the possibilities of aircraft in the protection from fires of the National Forests.

It is also of interest in this connection to know that in the summer of 1915 a flying boat was actually used to a limited extent for detecting fires in the Wisconsin State Forests, in the vicinity of Big Trout Lake. More recently, according to press reports, satisfactory tests were made of a seaplane for fire patrol in the British Columbia Forests, and it is understood that the Canadian Government has accepted the machine, which is capable of attaining an altitude of 6000 ft. and a speed of 65 m.p.h.

Our Timber Resources

Of the total area of the United States, approximately 24 per cent—representing 550,000,000 acres—is forested. The estimated value of the timber resources of the United States is more than six billion dollars. Statistics secured during the past three years (1915-1917, inclusive) indicate that the average annual damage caused by forest fires amounts to approximately $10,000,000. During this period no catastrophes occurred similar to the big fires in Minnesota during October of this year. No reliable figures are as yet available concerning the value of resources destroyed by reason of this catastrophe but it is reported that between 500 and 1000 lives were lost and an estimate of the damage to cities, towns, timber, farms and livestock would doubtless be conservative if placed at $100,000,000.

These statistics also show that there are upward of 28,000 forest fires annually in the United States, and that the average acreage burned over annually is more than 8,000,000 acres.

Present Fire Patrol Service

Since fire is the greatest menace to the forests, it naturally follows that protection against fire is the most important activity of the Forest Service. A permanent force is, of course, maintained on each National Forest for its administration and protection, additional men are employed where conditions warrant for the period of fire danger, which averages about four months—June to September, inclusive. The sole duties of this auxiliary force—ordinarily called the special protective force—are in connection with fire protection. This force usually comprises 2000 men, and its employment entails an expenditure of approximately $500,000.

A system of well selected lookout peaks, properly manned, and supplemented here and there with an auxiliary patrol when due to topography, or other factors conditions should warrant, usually suffices for reasonably prompt detection of fires. There are times, however, when by reason of thick smoke clouds from many fires burning at the same time, the lookout stations are put out of commission.

Our present detection system, therefore, while not perfect, is the best system possible under our financial limitations. This is why the Forest Service has not been prepared to experiment with aircraft in fire protection. However, no doubt exists in my mind that there is a distinct place for them in our work of protecting the forests, and eventually they will be used to advantage. Yet, in view of the great initial cost of aircraft, their relatively short period of usefulness or rapid depreciation, the comparatively excessive costs of maintenance and operation, as well as the fact that they would be needed only for not to exceed four or five months in any one year, the Forest Service as a Government agency would be handicapped in developing the necessary establishment. But the Government now has many aircraft and experienced flyers, observers, mechanicians, radio operators—in short, an efficient, seasoned aerial service which will, it is assumed, be maintained as distinctive divisions of the Army and Navy. In this event constant training must be had to maintain the desired efficiency. Beside purely military maneuvers, what better training would be available than the daily patrol of our forested areas? What a fine opportunity to prepare accurate photographic maps, as is done in actual warfare, to determine the accurate location of fires by co-ordinates in the same way that artillery fire is directed to a particular spot or object, to use the wireless in reporting the fires as has been done in communicating with the artillery.

Where Aircraft Would Prove Valuable

The present lookout system on the National Forests provides a continuous patrol. This is essential so that fires may be discovered in their incipiency, or at least before they have gained any appreciable headway. There would seem to be no reason why the same results should not be secured by patrols from aircraft. In fact, since the view is absolutely unobstructed, detection should generally be more prompt than is now possible, particularly in some localities of rugged topography, where fires may occur in deep canyons and the smoke is not visible from any lookout point until it has risen above a ridge. While it is the aim in determining the relative advantages of lookout points, to select those from which the greatest possible areas can be seen, it often happens that while some are so situated that excellent views may be had of the timber areas in several watersheds from the bottom of canyons to the ridges on either side, there are other points from which only the upper slopes may be visible. In rolling or flat country, with no commanding peaks, the view from lookout towers is comparatively limited, which means that a larger number of points must be selected for a given area or else riding patrol must supplement the stationary lookout patrol. As a means of prompt detection of fires in country of this character—for example, the forested regions of the Lake States, or Maine and other Eastern States outside of the mountain areas—aircraft patrol could doubtless not be excelled.

The use of aircraft for patrol of areas now covered by lookouts would obviously result in an appreciable reduction of the number of men who are now thus engaged. Whether all of them could be eliminated would depend for the most part on the number of aircraft used in fire patrol.

From the experience already gained in the use of aircraft, it would probably not be at all difficult to determine for a given region comprising a specified acreage the number of bases or aerodromes, the number of machines, and the number of men that would be required, as well as the regular aerial routes of patrol. The liability of value, location and areas of different timber types and the risk involved, as well as the availability of suitable landing places, would be factors influencing the determination of such patrol routes. The foresters and aviators would, of course, co-operate fully in every phase of the work.

Beside their use for fire detection, aircraft would be very valuable for scouting on large fires. Had aircraft been used in Minnesota, it is reasonable to assume that the awful catastrophe during October could have been averted. Yet, even assuming that the fires had been detected without delay by a system of patrol other than aircraft patrol, observers from aircraft could have given advance notice of the threatened danger, and could have directed fire fighters to the most dangerous areas, and what is even more important, they could have facilitated rescue work. Criminal negligence, coupled with an inadequate patrol system due to lack of sufficient funds, were, in short, the chief causes of the terrible loss of life and the enormous property and timber losses.

Aerial Fire Fighters Possible

The experience of forest officers in fighting fires in the National forests of the Western States has emphasized the importance of having an efficient scouting service on every large fire. Where a fire is confined to one watershed its progress can usually be determined from some high point. But often a fire may be burning in several canyons at the same time. The general topography of the country, but more specifically the depth and width of the canyons, may influence wind condi-

tions to such an extent that a fire in one canyon may be headed in one direction, while in the next canyon the fire will be burning in the opposite direction. If the fire covers a fairly large area—for instance, ten or more square miles of a rough mountainous country containing no inhabitants and practically no transportation system, and where the timber and underbrush are so thick that trails must be cut before a pack outfit can reach a suitable site with a camp outfit for the fire fighters—the difficulties encountered by a fire scout are readily realized. It is his job to determine each day how the fight is progressing, where fire lines should be constructed, where lines need reinforcements, in short, he must secure a detailed knowledge of the country before he can devise plans of combating the fire. In much of the timbered country of the Western States it is difficult to travel on foot more than a mile an hour due to steep slopes and thick underbrush. The use of aircraft for scouting purposes under such conditions should prove most efficacious. It is understood that aircraft were used most successfully in directing the forces engaged in fighting the big fire in munition warehouses in New Jersey several months ago.

It is probably premature to discuss the value of aircraft in actual forest fire suppression work. I have indicated how aircraft, in my judgment, can be used in detecting fires and for scouting purposes. Some types of aircraft would lend themselves to the transportation of fire fighters. The suggestion has also been made that bombing planes could be used to advantage in that fireproof bombs, consisting of certain chemicals, could be hurled on fires in sufficient quantities to extinguish them. How practicable a scheme of this kind might be remains to be seen. It goes without saying, however, that the adoption of aircraft for patrolling the forested areas of the country will create a large field for experiments of many kinds.

The World's Aerial Mail and Passenger Services

The general directory printed herewith has been compiled from the most up-to-date information at hand, and contains a comprehensive outline of the world's aerial mail, passenger and express services, those in operation as well as those projected.

United States

(1) *Washington Philadelphia New York* (128 + 90 = 218 miles). Daily mail service, Sundays excepted, by means of Curtiss and Standard biplanes (150 hp. Hispano-Suiza engines). Operated by the Post Office Department. Inaugurated May 15, 1918. Average time, Washington-New York, 2 hr. 30 min., New York-Washington, 2 hr. 50 min. Postage, first-class mail only, 6 cents per ounce, with special delivery service, 10 cents additional.

This line will eventually be extended from New York via Boston to Montreal, and from Washington via Atlanta to Key West, Fla., where it will connect with a line from Key West via Havana to Panama, and one from Key West via the West Indies to South America. Feeder lines will also be established from Philadelphia to Pittsburgh, from Washington to Cincinnati, and from Atlanta to New Orleans.

(2) *New York-Bellefonte, Pa.-Cleveland-Chicago* (215 + 215 + 323 = 753 miles). Daily mail service, Sundays excepted, by means of Curtiss R4-L and DH-4 biplanes (400 hp. Liberty engines). Operated by the Post Office Department. To begin operations shortly. Average time, estimated, 9 hr. Postage, same as above.

This line will eventually be extended from Chicago via Omaha, Denver and Salt Lake City, to San Francisco, with feeder lines from Chicago to St. Louis and Kansas City, from Chicago to St. Paul and Minneapolis, from Cleveland to Pittsburgh, and from Salt Lake City to Seattle.

Austria

(1) *Vienna Budapest* (140 miles). Daily mail service, inaugurated July 5, 1918. Postage, Kr. 5.10 ($1.00).

Denmark

(1) *Copenhagen-Odense-Fredericia Esbjerg* (170 miles).
(2) *Copenhagen-Kalundborg-Aarhus* (105 miles).
(3) *Copenhagen-Gothenburg-Christiania* (330 miles). Daily mail service projected.

France

(1) *Paris-Le Mans-Saint Nazaire* (250 miles). Daily mail service by means of twin-engined Letord biplanes (Hispano-Suiza engines). Inaugurated Aug. 15, 1918. Average time, 3 hr. Postage, 75 centimes (15 cents).
(2) *Paris London* (240 miles).
(3) *Paris-Lyons* (240 miles).
(4) *Lyons Marseilles* (165 miles).
(5) *Marseilles Nice* (140 miles).

Air mail lines (3) to (5), now being organized, will constitute the French section of an Inter-Allied air mail service to be established between London, Paris, Rome and Constantinople.

(6) *Nice-Ajaccio, Corsica* (150 miles). Daily air mail service by means of flying boats, about to begin operations.

Various air mail lines, operated by the military, are functioning in Southern Algeria and Morocco, chiefly for carrying official correspondence. The organization of an air mail line from Marseilles via Algiers to Timbuctoo is now being worked out; the sections Biskra Wargla (240 miles), Wargla-Inifel (211 miles) and Inifel-In Salah (223 miles) are in operation.

Germany

(1) *Berlin-Munich* (350 miles). Daily mail and passenger service, weather permitting. Average time, 4½ hr. Passage, $1 per mile.

Several other mail and passenger services are operating between the larger cities, but no details are available.

Great Britain

(1) *London-Paris* (240 miles). Daily passenger service, weather permitting, by means of twin-engined DH-10 biplanes. Now being jointly organized by the Aircraft Transport and Travel, Ltd., of London, and the Compagnie Générale Transaérienne of Paris. Average time, 2½-3 hr. Passage, both ways, $75.

Greece

(1) *Athens-Janina* (200 miles). Daily mail service, inaugurated Aug. 8, 1918.
(2) *Athens Salonica* (220 miles). Daily mail service, projected.

Italy

(1) *Civitavecchia-Terranova, Sardinia* (150 miles). Daily mail service by means of flying boats. Inaugurated June 27, 1917, temporarily discontinued during the winter of 1917-18, reopened in March 1918. Average time, 2 hr.
(2) *Venice-Trieste* (70 miles).
(3) *Venice-Pola* (80 miles).
(4) *Ancona-Fiume* (130 miles).
(5) *Ancona-Zara* (90 miles).
(6) *Brindisi-Cattaro* (150 miles).
(7) *Brindisi-Valona* (100 miles).

Organized shortly after the signing of the armistice with Austria, operating.

(8) *Genoa-Nice* (100 miles).
(9) *Genoa-Florence* (120 miles).
(10) *Florence-Rome* (140 miles).
(11) *Rome-Brindisi* (290 miles).

Air mail lines (8) to (11), now being worked out, will constitute the Italian section of an Inter-Allied air mail service to be established between London, Paris, Rome and Constantinople.

Norway

(1) *Christiania-Stavanger Bergen-Trondhjem* (670 miles). Oversea route.
(2) *Christiania-Bergen* (200 miles). Overland route.
(3) *Stavanger-Bergen* (100 miles). Oversea route.

Projected air mail lines, to be operated by the Norwegian Air Routes Co.

(4) *Stavanger-Aberdeen, Scotland* (320 miles). Projected air mail line, to be jointly operated by the Norwegian Air Routes Co. and Aircraft Transport and Travel, Ltd., London.

Spain

(1) *Madrid-Barcelona* (320 miles).
(2) *Barcelona-Palma, Baleares* (170 miles).

Projected air mail lines, to be operated by a Spanish company.

British Airship Development and Operations

The British airship service, while nominally a branch of the Royal Air Force, is in fact attached to the Royal Navy because the scope of its operations is purely naval. For this reason the work accomplished by British airships during the war, as well as developments in design have, up to the signing of the armistice, been kept as secret as the other operations of the "silent service." Considerable interest attaches therefore to the following semi-official statement, issued by the British Air Ministry, as it affords the first authoritative presentation of the development and operations of British airships during the war. The figures given relative to man power required for operating airships, casualties per flight mileage, and non flying days, are particularly worthy of note.

The outbreak of war found the Royal Navy in possession of seven airships, all of the non rigid type. On October 31, 1918, the number was 103, including rigid and non-rigids. Four of the original seven had been taken over from the Army on December 31, 1913. The first British airship, "Nulli Secundus," appeared in the air in 1907. She was of the semi-rigid type. That is to say, she had a rigid framework running fore and aft along the bottom of the envelope, and to this the car was attached. She was deleted before the outbreak of war. The "Beta" dated from 1910. She was a non-rigid, and the car was rigged to a girdle of fabric stuck and sewn round the envelope. Later in the same year the "Gamma" was produced, and was the first Army airship to be fitted with swivelling propellers. The "Delta," built in 1912, was remarkable for the use of "dope" on her envelope to prevent gas leakage. The "Eta," built in 1913, gave her name to the "Eta patch" system of attaching rigging cables to the exterior of the envelope. This was a great improvement on the girdle system. These last four ships were in use when war broke out, and the "Beta" observed for the Belgian artillery in 1915.

The Navy commenced airship experiments in 1911 with a rigid, which was accidentally broken in two before she made a flight. Nos. 2, 3, and 4 were non rigids. Of these No. 2 was the parent of the S. S. (Submarine Scout) type. No. 3 was an Astra Torres, trilobe in shape, with internal rigging, built in Paris. No. 3 patrolled the Channel during the crossing of the Expeditionary Force, and was subsequently employed for a while in Belgium. No. 4 was a Parseval, bought from Germany, of 360,000 cubic feet capacity. The Parseval type is rigged externally to a girdle. On the night of August 5-6, 1914, this ship patrolled the Channel from 7 p.m. till 5.30 a.m.

Non Rigid Airships

During the war four types of non-rigid airships have been constructed in Great Britain—Parseval, Submarine Scout, Coastal and North Sea. Of the last three, the S.S. is rigged externally to Eta patches, while the Coastal and North Sea use the Astra system.

Small S.S. ships were first constructed in 1915, and at once proved their value. An improved class known as S.S. Zero held the field until the advent of the S.S. Twin in 1917. The Zero has a blunt-nosed envelope, with its greatest diameter about a quarter of the length from the nose. Its cubic capacity is 70,000 ft., its length is 143 ft., and its greatest diameter 29 ft. The car carries a crew of three. The record flight for a Zero lasted for 50 hr., 55 min.

The Twin has, as its name implies, twin engines, two 75 hp. Hawks. Its capacity is 100,000 cu. ft. Its length is 164.5 ft., the greatest diameter being about 32 ft. It is considered a most useful and satisfactory class, and is now supplanting the other S.S. classes.

The Coastal type has a capacity of 200,000 cu. ft., and its car will hold five men. Airships of this type did most of the long distance patrols during the last two years of the war, and were largely employed in convoying ships from beyond the Scilly Isles up the Channel. Their work has been most satisfactory, but they are now being supplanted by an improved class known as the C* (Coastal Star). It is slightly larger (211.56 ft. long and greatest diameter 42.8 ft.), and the envelope is of a better stream line shape to minimize air disturbance. The first C* appeared in January, 1918, and nine more were added before Oct. 31. The C* has a 110 hp. Berliet forward and a 260 hp. Fiat aft.

The "North Sea" type was designed as a scout to act with the fleet or to carry out patrols of 20 hr. Its envelope has a capacity of 360,000 cu. ft., and the car can carry a crew of 20, the normal crew being 10. Since the signing of the armistice a North Sea ship has made a flight of 61 hr., 21 min., which is a record for a non-rigid, and is believed to have been surpassed only by two performances of German Zeppelins. The length is 262 ft., greatest diameter 55 ft., and it is fitted with two 275 hp. Eagle or two 260 hp. Fiat engines.

British Coastal Type Airship
(C) Underwood and Underwood

Rigid Airships

After the misfortune to the first naval airship no rigid was produced in Great Britain until December, 1916, so that this country was for the first two years of the war some twelve years behind Germany in the construction of rigid airships. By Jan. 1, 1918, however, four British rigids were in commission. This type is composed of frames of duralumin girders. The whole framework is enveloped in a fabric cover. Inside are the gas bags, which are thus protected from the action of sun and moisture. No. 23, which has recently been seen several times over London, is 540 ft. long and has a cubic capacity of approximately 1,000,000 ft. A more recent British rigid has a capacity 50 per cent greater, while others larger still are on the stocks.

Functions of Airships

During the war the functions of airships have been two—namely, to combat the submarine menace and to act as scouts for the fleet. Bomb-dropping raids over land were not attempted by British airships, and were only considered of minor importance by the Germans.

Rigid airships are the best of scouts for a fleet. The German fleet owed their escape after the battle of Jutland to their Zeppelins. It was Zeppelins which made possible the escape of the flotilla which raided Scarboro' on Easter Monday, 1916, and it was Zeppelins which enabled U-boats to torpedo H.M.S. Nottingham and Falmouth.

The struggle with the submarine menace entailed two sorts of work, patrol and convoy. While on patrol the airships, particularly the S.S. type, were able to compass the destruction of numerous submarines, either by using their own bombs or by summoning surface craft. They were also able to direct vessels out of a danger zone. Mines were likewise observed and destroyed.

The system of convoy by airship proved extremely successful. No ship was ever sunk while under escort from the air. This work was very arduous and required constant vigilance.

Airships are not so independent of weather as are heavier-than air craft, but it is interesting to note that in 1918 up to the signing of the armistice there were only nine days on which no flying took place.

Man Power Required

It is a popular belief that airships require an extravagant number of mechanics. When the number of flying hours is set against the number of hands employed, airships are shown to be more economical in man-power than heavier-than-air craft, as the following figures show.

	Airships.	Airplanes and Seaplanes
Man employed per hour flown	1.82	3.52
Hours flown per man employed	1.04	40
Average duration of patrol	6 hr. 17 min.	2 hr. 2 min.

The following table shows the hours flown from 1915 to Oct. 31, 1918.

	Hours
1915	[illegible]
1916	2,078
1917	22,389
1918	53,554

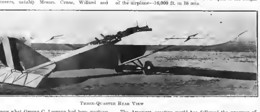
The total casualties to airship personnel during the war were 239, of which 48 were fatalities due to flying accidents and enemy action. For every fatality suffered, 42,548 miles were flown. In the airship service credit is claimed, not for losses suffered, but for losses inflicted on the enemy, and for averting losses from one's own side. When the potential destructiveness of each U-boat is considered, the services of the airships in securing the food supply of Great Britain and escorting troopships cannot easily be overrated.

Description of the Loening Monoplane

In his extensive report on American aviation recently made to the British Air Ministry, and circularized throughout the Technical Sections of the Allies, Col. Lord Sempill, R. A. F., reported in detail upon the Loening monoplane as one of the most advanced and original designs that have ever been produced, and with such great promise of success that it was well worthy of the most extensive development and study. American officers of both the Army and Navy Service and several American engineers, notably Messrs. Crane, Willard and Vought, who knew what Grover C. Loening had been working on for many years were confident and encouraging in their attitude so that when the final successful performances were announced by the War Department after its tests at Dayton, little surprise was shown except by those who have so erroneously maintained in the past that American designers were incapable of producing the most advanced types of fighting airplane by their own efforts.

Generally speaking, in its actual performance the Loening monoplane has, with the full two-seater fighter load carried by the DeHaviland, LePère, Bristol, etc., not only exceeded all the performances of these machines, but has with this same load equalled, if not exceeded, all of the performances of the very best European single seaters with the same engine, such as the Spad, Sopwith, Martinsyde, etc.

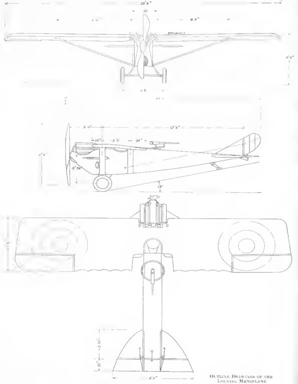
In the tests made by the manufacturer at Mineola during last summer and fall, the machine showed a high speed of 146 m.p.h., and on one occasion climbed to 24,000 ft. in 43 min. with pilot, passenger, two hours fuel and considerable gun equipment, thus establishing an unofficial height record for two-seaters. The new monoplane of the same type tested at Dayton by the U. S. Army showed practically the same high speed, and climbed—with a live load almost equal to the weight of the airplane—16,000 ft. in 18 min.



Three-Quarter Rear View

The American aviation world has followed the progress of this new design with great interest, and there is a somewhat general regret that the war should have ended before this machine could demonstrate, in actual service, the superiority of American high-speed fighter design. However, there are so many other uses that a machine of this type can be put to that continued development is looked forward to and promised by Mr. Loening.

The first monoplanes of this type were, as a matter of fact, ordered from Mr. Loening by the Wright-Martin Aircraft Corp., for the express purpose of serving as flying laboratories for the 300 hp. Hispano-Suiza engine of very high performance. The military advantages of the design, however, were so obvious that the machines were quickly taken over by the Air Service of the Army.



Outline Drawings of the Loening Monoplane

During the tests conducted by both the manufacturer and the Army at Mineola and at Dayton, a dozen or so expert military aviators repeatedly put the machine through every conceivable maneuver, and—as Mr Loening has frequently pointed out—their cooperation and assistance, in particular that of Capt. W P Jacobs, Lieut R A Willis, Capt Caleb Bragg, Col Smith-Barry, R A. F, O M Bounds, Major R W Schroeder, amongst others, has been of great value in developing the finer points of the machine.

One of the most important contributions to the art of aviation that is made by the Loening monoplane is in the novel design of the wing structure which gives a great strength against drift stresses and makes the whole machine a rigid unit, quite as strong and solid against twisting stresses as any biplane. The outstanding feature of the machine is the manner, original with Mr Loening, in which the wings fasten to the upper body longitudinals, and are braced by two enormous braces to the bottom of the body This method of wing bracing has so much simplified the construction of the machine, that it has permitted to cut in half the weight of airplane structures heretofore used

When it is realized that this machine weighs with the same engine and the same load, some 400 lb less in dead weight than, for example, the Bristol fighter, the greatly superior performances of the Loening monoplane are readily explained.

A very interesting feature of the design proven by the tests made is the slow speed on landing and general buoyancy of the machine, despite the fact that the wing loading has gradually been stepped up to almost 12 lb per sq ft

Construction

The wings, body, tail surfaces, landing gear, etc, are all built of most approved spruce and metal fitting airplane construction All metal fittings are of stamped sheet metal, with practically no brazed or welded parts, all joints are pin connected, particularly the joints of the main wing braces to the wings and body, which are free to move in any direction, so that vibration will not fatigue these members In addition to which, all parts are readily adjustable for alignment

Safety Factor

Sand load tests that have been carried on exhaustively to prove the strength of the machine show a safety factor of 14 on drift stresses, and a safety factor of 8 on lift stresses The machine has frequently been dived and there is no evidence that the wing structure is weak in any way, and sand load tests have shown that, owing to the deep chord and the excellent manner in which the wings are braced, the usual failures of monoplanes on drift stresses has been eliminated In fact, the wings on edge are strong enough to take a backward resistance in diving equivalent to the weight of the entire machine with an ample factor of security

All tail surfaces and fin surfaces, stabilizers, rudders, etc., withstand on actual sand test a load of 35 lb per sq ft area.

Throughout the machine, it is apparent that the design has been particularly studied for production in great quantities as the machine has been found to be extremely easy to build

Military Features

The visibility afforded to the pilot is so complete that he has practically no blind spots at all He can see either above or below the wings or to either side, and in addition to that can see quite well in the front, due to the narrowness of the body

Side View

These features, as combined on this machine, are the results of three or four years experimenting by Mr Loening which gives him priority over all others in the invention of this type of monoplane

The Gun Range

The gun range is also very good, particularly as the gunner can shoot forward, the only obstruction being the arc of the airscrew

The deep body offers ample room for all kinds of military equipment, oxygen tanks, wireless apparatus, cameras, etc., and in addition to that the arrangement of the cowls is such as to give the occupants ample protection against the wind without interfering with the view The construction has everywhere been studied so as to give maximum strength to all of the parts that are vital due to damage from bullets. This is particularly true of the main braces supporting the wings which can be half shot away before they will lose the safety factor of 8 provided

Engine Installation

The engine installation of the machine is particularly well studied Although the engine is left out in the open, it is found not to increase head resistance greatly, while it vastly improves the performance of the engine, and its durability, as it is not suffocated under a cowl The radiator is placed in a particularly advantageous location where it gets a full blast of air and in addition can be easily shuttered Practically all connections on the engine are accessible without taking off any cowls, and the whole installation is exceedingly easy to inspect and to erect The engine can be taken out without taking off the radiator, and the latter can be taken off without removing the airscrew In addition to that the design is so worked out that the front bulk head, instrument boards, engine bed, cowls, radiator, etc, all form one unit, made and connected up on a sub-assembly and parked as a unit, which greatly facilitates the final assembly of the machine

Performance

In exhaustive tests on flight performances of the machine it has been found that the machine lands very slowly, gets off the ground in 4 seconds from a dead start, and that in flight the machine is very easy to handle in all its controls in spirals, loops, barrel rolls, etc All of which maneuvers the machine appears to make with the celerity of a single seater

The performances of the machine with full load are as follows: Speed range, 48 m.p.h. slow speed to 146 m.p.h. high speed, indicated ceiling, 26,000 ft. light load, 22,000 ft. heavy load.

In addition to the usual maneuvers it is found that the machine will climb vertically for several hundred feet under perfect control and also that the design lends itself to an extraordinary quick barrel turn both of which maneuvers would appear to work and most valuable in air fighting.

There is no evidence on the extent of flying that has been made on this machine of the weakness generally attributed to monoplanes and the designers are confident that this whole prejudice is due merely to the faulty design of monoplanes that have been brought out. It is rightly pointed out that the Nieuport scout, for example, is aerodynamically essentially a monoplane, just as is this machine, but has not generally been found for its weight any weaker than similar light biplanes.

The distinctions between monoplanes, biplanes, triplanes, etc., are as a matter of fact very hazy since the whole question from an engineering standpoint is one of the distribution of weight and wing surface, and the efficiency with which the carrying surface is braced and blended into the design of any particular machine. It is generally conceded by those who have studied the Loening monoplane that it is one of the first designs in which the engine installation and the military features (mounting of instruments, guns, etc.), have been co-ordinated from the very start into an harmonious unit of great efficiency, because they were considered the fundamentals around which a simple airplane structure was devised.

The principal characteristics of the Loening monoplane are as follows:

Areas

	Sq. ft.
Main planes total	[illegible]
Upper planes including ailerons	214.0
Strut planes	24.0
Ailerons (2)	24.8
Fins	8.8
Stabilizer	14.0
Rudders (2)	11.0
Elevator	17.8

Weights

	Lb.
Weight, empty	[illegible]
Fuel and oil	[illegible]
Military load	684
Total weight	2,508

Power Plant

Engine Hispano-Suiza, model H, developing 340 hp. at 1,800 r.p.m. Weight including airscrew 619 lb. Fuel consumption per hp. hr. 0.53 lb.

Performances

Altitude	Speed	Climb
Sea level	146 m.p.h.	0 min.
20,000 ft.		20 min.
24,600 ft.		

Europe Organizing Passenger Air Lines

Mr. Holt Thomas, whose paper on commercial aeronautics read before the Royal Aeronautical Society in May, 1917, is generally regarded as a classic on the subject, has made public through the London press his plans relative to the transportation of passengers and mails by airplane. It should be noted that Mr. Thomas is president of the Aircraft Manufacturing Co., Ltd., of London, which firm has produced to the designs of Capt. G. de Haviland, R. A. F., the various DH airplanes.

"The whole essence of aerial transport," Mr. Thomas is quoted saying, "is speed. The journey from London to Paris, for example, must be covered in two hours and a half, or less. Before the war it took by the quickest route about seven hours. If an airplane goes only 50 miles an hour and takes about five hours on the journey it is not in the least likely that anybody would care to travel by it. But at a hundred miles an hour the position is quite reversed, and the comparison between aircraft and other means of travel is to the great advantage of aircraft.

To Use Twin-engined Planes

"We have specialized in the last eighteen months on weight-carrying, combined with high speed. The D.H. 10, for instance, which was designed for long-distance bombing raids into Germany, but will now be used for commercial purposes, according to the official records does 128 m.p.h., carries 3,250 lb., climbs 5,000 feet in five minutes, and, what is perhaps more marvelous for a two-engine machine of this type, loops the loop and performs any acrobacy which is usually only demanded of a fighting scout.

"There is, indeed, no quality that the war has enforced upon our designers which is not absolutely necessary for the commercial machine. We shall use the D.H. 10 for commercial purposes in the immediate future, and carry, I hope, mails as well as passengers.

"I have been just as enthusiastic over commercial transport as I was ten years ago over the use of aircraft for military purposes; and although naturally we have been compelled to devote ourselves entirely to war purposes, it has not prevented us from making our preliminary arrangements.

"The first point I have recognized with regard to linking up the world by aerial route is the fact that, very unfortunately, British celestial rights apparently end in mid-Channel. It is very unlikely, therefore, that the French Government will allow an all-British enterprise to run a mail to Paris, or that the Italian Government will permit an all-British mail to Rome, or the Indian Government an English mail to Madras, without Italian and Indian interests being considered. Nor is the Norwegian Government likely to allow a mail from Aberdeen to Stavanger without Norwegians as well as British being behind it. An aerial service between London and Paris must necessarily include the rights of Franco-British capital, Franco-British aircraft construction, Franco-British pilots, and, indeed, an international combine in every detail.

"Facing these facts—for I think they are facts—I have been for a long time past making certain arrangements. In Norway I have caused to be started a company of national importance, 'Det Norske Lufttrafikrederi Aktieselskap,' at Christiania for the purpose of joining up with my company, Aircraft Travel and Transport, Ltd., which is under exactly the same direction as the Aircraft Co. and my other aviation enterprises, with the object of organizing and of establishing an aerial mail between Great Britain and Norway.

"In the same way my allied company in France, the Compagnie Générale Transaérienne, has an agreement with mine generally as to aerial services between France and England.

London to India

"In Italy I am in alliance with the Società Transporti Aerei Internazionali, of which our recent celebrated guest in London, Prince Colonna, is president. I expect the Aerial Transportation Co. of India, whose business interests are in the hands of Messrs. Tata, Ltd., to link up the still further journeys from London, through France and Italy to India. Arrangements are also completed for another link throughout South Africa, from the Cape to Cairo.

"In the paper I read before the Royal Aeronautical Society in May, 1917, I took as a safe actual speed 80 m.p.h. We could, I think, now take 100 miles, as we have machines doing 130. But taking the same figure of 80 m.p.h., Rome can be reached by aerial service in 12½ hours from London instead of 42 hours by the quickest route before the war, and Constantinople in 20 hours instead of 72. At the same speed, which I think is underestimated on today's conditions, Bombay is about two days' journey by air from London, and Tokyo four or five days.

"The commercial machine, even though it should be going on a journey from England to India, must always be within touch, not necessarily of an aerodrome, but of an alighting ground. My idea is that there should be landing grounds every ten miles throughout the world, with wireless or telephone means of communication with depots, so that if, say, your mail came down through engine failure, all that a pilot would have to do would be to telephone to the nearest depot, 'I am down with engine failure on Ground 18,' and within a very short period a fresh machine and a fresh pilot would be speeding to his assistance."

Aircraft Manufacturers' Banquet

The banquet of the Manufacturers' Aircraft Association, which took place on Jan. 7 at the Hotel Waldorf Astoria, was one of the most notable gatherings which have brought together the aircraft industry and the air services in a proclamation of faith in the future of aerial navigation.

Among those present were: Major-Gen. W. L. Kenly, Director of Military Aeronautics; Col. J. A. Mars, Director of Aircraft Production; Capt. N. E. Irwin, U. S. N., Director, Naval Aviation Division; John D. Ryan, W. C. Potter, Dr. S. W. Stratton, Secretary, Bureau of Standards; Grosvenor B. Clarkson, Director, Council of National Defense; Rear Admiral William S. Smith, of the Naval Consulting Board; Otto M. Praeger, Second Assistant Postmaster-General; Col. W. A. Bishop, R. A. F.; Major H. Dourif, French Air Service; Lieut. A. Cantoni, Italian Royal Air Service; Frank H. Russell, Benjamin S. Foss, and Harry B. Mingle, president, secretary and treasurer, respectively, of the Manufacturers' Aircraft Association; Col. W. S. Patterson, Lieut.-Com. R. M. Reum, Major A. C. Moore, Major H. W. Lake, Lieut. Col. Oscar Westover, Lieut. Col. L. S. Horner, Lieut. L. Belom, A. G. Batchelder, Glenn L. Martin, Lieut. Col. B. T. Castle, L. D. Gardner, Major C. B. Ely, Col. W. E. Gillmore, Col. A. Miller, Col. H. W. Gregg, Lieut.-Col. Chester Goodier, Lieut. Com. H. Wesson, U. S. N., Lieut.-Com. H. B. Luther, U. S. N., Capt. Robert A. Bartlett, Major James Barnes, Major Howard Wehrle, Lieut. Com. N. B. Hall, Chas. F. Willard, Lieut.-Col. G. W. Mixter, Lieut. Col. W. F. Harmon, Dr. Jas. S. Ames, W. Redmond Cross, W. D. Gash, Lieut.-Col. J. S. Sullivan, Col. S. E. Wolf, Major G. R. Wadsworth, E. R. Preston, Willard Seiberling, E. F. Gallaudet, Rodman Wanamaker, C. B. Manley, Glenn H. Curtiss, Com. J. H. Towers, U. S. N., Lieut. Col. T. E. Gilmore, Col. F. R. Kenney, Col. E. A. Deeds, S. S. Bradley, Murray Hulbert, Brig.-Gen. C. F. Lee, W. S. Saunders, C. H. Day, W. Benton Crisp, Lieut.-Col. H. C. Marmon.

Silent Tribute to Roosevelt

The banquet opened with a silent toast to Theodore Roosevelt, those present rising to their feet in the darkened room, after which Chairman Frank H. Russell introduced the speakers of the evening. Excerpts from some of the speeches are printed herewith.

Colonel Bishop's Speech

Speaking of the future of aviation, one can only say that aviation has been made by this great war. At the beginning of the war it was a dream of the pioneer fliers that flying machines should help to scout and do other work, and they did at the beginning of the war, but no dreams that those pioneer fliers could possibly have had could picture the wonderful development which aviation has had during the past four years.

I feel convinced—and really I have seen airplanes do some extraordinary things—I feel absolutely convinced that the future of aviation is not in warfare, it is in commerce, and I think that the wonderful record the science of flying has had will be equaled and surpassed in the next few years by the development of commercial aviation. The first startling thing will be the trans-Atlantic flight, and as every man here knows that is not far off—not for one machine, but for many machines.

At the end of another year, I feel quite confident that scores of machines will have crossed the Atlantic.

And a great number of men here tonight will doubtless take that trip. This trip will without doubt be done not only in the big machines, but in the small machines. Both of these types have their advantages for commerce. The general idea amongst the outside public seemed sometimes to be that the only machine fit for commercial purposes is the big, many engined machine. This machine undoubtedly has tremendous advantages in carrying weight, in going long distances, and, by reason of its two, three or four engines, it may be more reliable, but the engines which have been turned out of late in your country, in England and France and Italy, have shown us that single engine machines may now be reckoned upon to be absolutely reliable, and that a person flying a machine with one engine, one of the good ones, may rely on that engine not to let him down.

This is undoubtedly the biggest step that flying has taken, because in the past the people were very frightened of flying over bad country, continually worrying, I have done it myself, of landing in corn fields, and like fields, woods and all sorts of things—now with engines that one can rely on, we feel absolutely confident that it will carry you through. The little machine, by which I mean the two, three, or four passenger machine, will be cheaper to run, cheaper to handle on the ground and cheaper in every way. It will, of course, not bring the same results, with the one exception of speed, and it will always be the fast machine.

John D. Ryan's Speech

I think the peace requirements—and I don't believe I am over optimistic—will in time startle the world. I don't think it is coming today, and I should regret very much if it were pushed too much. I think with care and caution and development, and trial, that the airplane can be made as necessary in peace, almost as it is in war, and I believe it is in good hands. I am out of the aircraft, as you all know, I am back a plain citizen, but I have great interest in it and its future. I should hate above all to see aircraft, particularly for the defense of the country, go by the board.

I should think that it would be plain to almost anybody that in the necessity for the defense of a great country like ours, with a great coast line like ours, a very extensive aircraft program is a very desirable thing. I think the science of aviation should be encouraged in every possible way. I would have an academy of aviation, just as we have a military academy at West Point, and a Naval Academy at Annapolis. I would educate the boys in this country from the time they are boys, in aviation, strictly and almost exclusively, and I think that with the proper expenditure and the proper direction, that within five years from now an enemy fleet that attempted to reach the shores of the United States would be detected and located so far out at sea that it would be put out of business three or four hundred miles beyond the reach of the shore.

We now have planes that have a long range, we will have planes with a longer range, not necessarily the fastest planes, but planes with a long range that could absolutely detect the presence of a hostile fleet on its way to these shores, at least five or six hundred miles before they could reach us. Not depreciating in any way the great naval defense that we want in this country, and that we must have, I would say the planes could locate the fleet and the navy could destroy it. We could be told where it was and destroy it before it could reach us.

Otto Praeger's Speech

What the Post Office Department will need is a plane capable of meeting the needs of commerce, and as far as we are concerned we are going to continue to salvage such of the material as the Secretary of War and the Secretary of the Navy will turn over to us, adapting their methods to mail needs. We can just as well do that as to buy new planes built along the old lines.

So today I am satisfied you will have a machine that will not only meet the wants of the Post Office Department, but of commerce generally. It should be a machine that will not have marvelous speed, terrific climb, or great ceiling at the expense of carrying capacity, or stability, or strength of construction. Also, it must be a machine that will overcome the radiator troubles, and those score of troubles that develop in the air and force landing.

When you get such a ship—and I don't think it will be very long until you solve those problems—then you will have a machine which will command a market outside of the Government needs, which will be in such demand that all the orders that you get from the War Department or the Navy, or the Post Office Department, will pale into insignificance in comparison with what you will get from the commercial world.

You must realize, naturally, that under such conditions the development of the aerial mail is going to be slow, and upon the development of commercial machines, which will be dependable in cross-country work, is going to depend not only the rapidity of the progress of the aerial mail, but of all aviation.

News of the Fortnight

Our Air Service in France

A brief review of operations of the American Air Service in France, up to November 12, is contained in a cable from Major General Harbord to the Director of Air Service. It is dated December 18 and below is a summary.

There were in operation on the front thirty-nine American Aero Squadrons, distributed as follows: Twenty pursuit, one night bombardment, six day bombardment, five army observation, twelve corps observation and one night observation.

Enemy planes, brought down by American flyers, included 491 confirmed and 354 unconfirmed, making a total of 845. A total of eighty-two enemy balloons are reported as destroyed, of which fifty-seven were confirmed. On the other hand, the Air Service lost only 271 planes and forty-five balloons.

Concerning commissioned personnel casualties, there were 109 killed, 103 wounded, 200 missing, twenty-seven prisoners and three interned, making a total of 442.

The Air Service included in the zone of advance 2161 officers, 22,351 soldiers, a total of 24,512 at the actual front. There were also 4643 officers and 28,353 soldiers in the service of supply. With the French armies there were detailed eight American flying officers, and with the British Expeditionary Forces forty-nine officers and 525 soldiers. The total personnel in France consisted of 6861 officers and 51,229 soldiers, a total air strength of 58,090. Air Service mechanics regiments with the French Army included 109 officers and 4744 soldiers.

The flying personnel under instruction included 1323 pilots, assigned as follows: preliminary, 126; advanced, 29; pursuit, 850; observation, 140; day bombing, 77, and night bombing, 101.

Observers in training included 563 artillery, 65 day bombing and 61 night bombing, a total of 689 officers. This made the aggregate in training 2012. The flying personnel awaiting instruction included 155 pilots and 59 observers.

Graduations included 6069 pilots, divided as follows: Preliminary, 1573; advanced, 2359; pursuit, 1160; observation, 723; day bombing, 329, and night bombing, 25.

Also a total of 2045 observers divided as follows: Pursuit, 88; artillery, 1425; day bombing, 390, and night bombing, 142.

A total of 159 individuals is reported as having been killed in training.

The number of planes, by type, received from all sources by the A. E. F. between Sept. 12, 1917, and Nov. 18, 1918, is as follows:

Pursuit for service, 3337; pursuit for schools, 90.
Observation for service, 3421; observation for schools, 664.
Day bombing for service, 421; day bombing for schools, 85.
Night reconnaissance, 31.

Other planes received included 2285 training planes, 30 experimental planes and 108 miscellaneous, making a total of 10,472.

Eight different schools under American control were established in France and designed for training 3800 officers and 11,700 men, as follows:

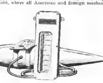
Tours—Observers: 916 officers and 2121 soldiers.
Issoudun—General flying: 2175 officers and 6100 soldiers.
Clermont-Ferrand—Bombardment: 120 officers and 660 soldiers.
St. Jean des Monts—Aerial gunners: 92 officers and 1500 soldiers.
Souge—Artillery firing point: 256 officers and 750 soldiers.
Coetquidan—Artillery firing point: 25 officers and 120 soldiers.
Meucon—Artillery firing point: 20 officers and 110 soldiers.
Chatillon sur Seine—Observers: 204 officers and 373 soldiers.

New Firm with a New Object

The United Aircraft Engineering Corp. has just been organized by E. G. Diffin, Roy U. Conger and M. B. Stout, with offices at 52 Vanderbilt Avenue, New York, with the object to promote the development of commercial and military aeronautics, to make the abilities of the leading aeronautical engineers available to the industry in this endeavor, and to develop aircraft engineering, the work to be international in its scope.

B. Russell Shaw Invents Vertimeter

With the release from the Airplane Engineering Division of the technical men who have been serving the Government during the war, the industry will be able to obtain detailed information of recent developments in aeronautics at first hand. Among those who have of late left the service to take up the work of consulting aeronautical engineer is B. Russell Shaw, who during the war was Assistant Director of Flying at McCook Field, where all American and foreign machines were



tested under his supervision. Mr. Shaw's active interest in aeronautics dates from 1908. He has built and flown a number of machines of his own design. In the early days he was in charge of the engineering department of the Wright Brothers, and before entering war service was a designer for the Wright-Martin Aircraft Corp.

Mr. Shaw has recently developed an instrument called Vertimeter, which indicates to the pilot at a glance the rate of ascent and descent.

The instrument is small and easily mounted on the dash. The readings are made easy by a direct and large scale. The Vertimeter consists of a head or the instrument proper and a nickel-plated stream line tank which mounts on the under side of the airplane body. Any small variation in the steady climb or descent of the machine is instantly shown on the instrument, which makes it possible to maintain a steady climb.

The Vertimeter registers zero within five seconds after a level flight is started at any altitude, and this reading is not affected by opening or closing the engine throttle, as is the case with all statoscopes now on the market. This instrument also prevents stalls while flying through a fog by indicating to the pilot the instant he has reached or passed his maximum climb.

The Vertimeter is manufactured by the Aeronautic Instrument Co., 32 East 23rd Street, New York.

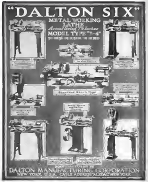
New York to Have Flying Police

New York City Police aviators will begin work next Spring, when the new police aviation system is put into active operation. This announcement was made December 22 by Major Walter L. Fairchild, president of the Board of Governors of the Aviation School, who said that plans were complete and that the training of the pilots had begun already.

The school is under the supervision of Special Deputy Commissioner Rodman Wanamaker, and is a department of the Police Reserves. Harry S. Harkness is Chairman of the Executive Committee and Jefferson De Mont Thompson is in charge of the Finance Committee. The school was moved December 1 to the Arsenal Police Station, in Central Park at Sixty-sixth Street, where 150 men are in training under Capt. A. L. G. Fritz.

Polar Exploration by Air

Announcement is made that plans are maturing for the exploration of the north Polar regions next summer by means of airplane. It is understood that Capt. Robert A. Bartlett, who commanded the *Roosevelt* in a previous expedition, is slated to head the new venture.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METAL WORKING LATHE
Actual Swing 7½ Inches
MODEL TYPE "B-4"
Standard Bench Type
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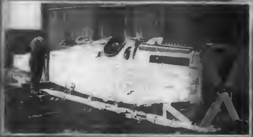
OVER THERE

First train load of American Planes to arrive. "Over There"-All D.H.4's from our plant. May. 13, 1918.



Assembling the first Fuselage May, 16, 1918.

Above train load of our Planes, after unloading in France.

Captain Osborn about to fly the first Plane May 17, 1918.

Manufacturers for the United States Government

The Dayton Wright Airplane Co.

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"The Birthplace of the Airplane"